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3.	Full name, address and postcode of the or of each applicant (*underline all surnames*)	**COLORMATRIX EUROPE LIMITED** 9 Unity Grove, Knowsley Business Park, Merseyside L34 9GT
	Patents ADP number (*if you know it*)	06985329001
	If the applicant is a corporate body, give the country/state of its incorporation	U.K.
4.	Title of the invention	THERMOPLASTIC POLYMER ADDITIVE COMPOSITIONS
5.	Name of your agent (*if you have one*)	~~W. P. THOMPSON & CO.~~ Appleyard Lees
	"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	~~Coopers Building, Church Street, Liverpool L1 3AB~~ 15 Clare Road HALIFAX HX1 2HY
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DUPLICATE

THERMOPLASTIC POLYMER ADDITIVE COMPOSITIONS

This invention relates to thermoplastic polymer additive compositions and their use. In particular it relates to such additive compositions that are useful as colour stabilisers for thermoplastic moulding compositions and thermoplastic materials, especially when such materials are recycled.

Polyethylene terephthalate is widely employed in the manufacture of packaging items. One large application for polyethylene terephthalate is in the manufacture of food packaging items and, in particular, beverage bottles. Such beverage bottles are extensively utilised for carbonated soft drinks and are increasingly more attractive, for safety considerations, in the packaging of alcoholic beverages such as beer. Bottles used for still or carbonated water or other soft drinks are typically colourless, green or blue. However, this invention is particularly, although not exclusively, concerned with colourless and near-colourless bottles.

Other uses for polyethylene terephthalate moulding compositions include the manufacture of packages for agrochemicals, cosmetics, detergents and the like.

Polyethylene terephthalate bottles are usually manufactured using a two stage process. Granules of the polyethylene terephthalate, along with any relevant additives, are injection moulded in a first step to produce a preform. The

resulting preform is then blow moulded, possibly at a different factory, in a second step to the desired shape. Machines are also available which make bottle preforms and then blow them immediately into bottles.

Typical temperatures required for injection moulding of polyethylene terephthalate moulding compositions are between about 260°C and about 285°C or higher, e.g. up to about 310°C. Somewhat lower temperatures in excess of about 100°C up to about 170°C or more are generally used in the blow-moulding step to produce a bottle from a polyethylene terephthalate preform.

It is a recognised phenomenon within the industry that use of extended dwell times at elevated temperatures, particularly during the injection moulding step used to make a polyethylene terephthalate bottle preform but also possibly during the subsequent blow moulding step, may tend to result in an inferior colouration of the preform or blow moulded bottle, in particular by yellowing of colourless materials, and/or inferior light transmission (e.g. haze, clearness or clarity) properties.

It is further recognised that, with an increase in usage of polyethylene terephthalate and other thermoplastic materials for manufacture of packaging and other articles, a greater need arises to address the problem of disposal of the waste material. With land fill space becoming evermore scarce and with society being generally more environmentally aware than ever before, there is an increasing demand that the recycling option be taken. A limited amount of

recycled polyethylene terephthalate material is already employed to produce strapping for packaging. Recycled polyethylene terephthalate is also used in the fibre industry to provide such products as wadding and sound insulation for cars and carpets. However, a more satisfactory option would be to recycle colourless or substantially colourless packaging of a sufficient quality such that it may be reused for food or drink applications. Presently, colourless polyethylene terephthalate material may be recycled or reused either with or without the addition of colouring. However, the recycling of colourless polyethylene terephthalate can give rise to a yellowing of the recycled material. The light transmission properties (e.g.haze, clearness or clarity) of the recycled material may also be unsatisfactory compared to the original material.

Other thermoplastic materials that are in widespread use include polyolefins, such as polyethylene and polypropylene, and polyvinyl chloride. However, this invention is concerned only with polyethylene terephthalate.

It would be desirable to be able to recycle previously used colourless or substantially colourless polyethylene terephthalate in order to produce a material whose colour would permit it to be recycled for further use, for example as a recycled, colourless or substantially colourless, polyethylene terephthalate bottle.

There is a need to provide a thermoplastic polymer additive composition for incorporation into polyethylene terephthalate moulding compositions that will

stabilise the colour of the polyethylene terephthalate on injection moulding and/or on recycling. There is a further need to provide a substantially colourless polyethylene terephthalate moulding composition that, after having been formed into bottles or other moulded articles, is suitable for recycling to make further bottles or other articles of a commercially acceptable colour.

There is a further need to provide colourless or substantially colourless blow moulded articles, such as bottles, and colourless or substantially colourless preforms therefor, which exhibit good gas barrier properties and which provide protection for the contents against ultra-violet light, and which have a good recycling potential.

It is an object of the present invention to provide recycling potential to colourless articles made from polyethylene terephthalate where that has not been possible or desirable previously due to restrictions placed upon the utility of the recycled material as a result of its colour and/or light transmission properties.

According to one aspect of the present invention there is provided a thermoplastic polymer additive composition for addition to a thermoplastic moulding composition, said additive composition comprising at least one hindered amine light stabiliser and at least one acetaldehyde scavenger.

It is postulated that the deleterious effects on light transmission and/or on colour properties of polyethylene terephthalate moulded articles apparently

caused by acetaldehyde scavengers can be mitigated by the inclusion in the melt of a hindered amine light stabiliser. Accordingly, the present invention provides the use of a hindered amine light stabiliser as an additive in a polyethylene terephthalate moulding composition comprising an acetaldehyde scavenger to reduce discolouration and/or haze after moulding of the composition. The moulding composition may be a recyclate, in which case the use of a hindered amine light stabiliser is thought to be particularly effective in reducing discolouration and/or haze, which may occur as a result of solid stating procedures used during recycling.

It may also be the case that hindered amine light stabilisers are capable of reducing acetaldehyde content in their own right. Accordingly, the invention also provides the use of a hindered amine light stabiliser as an additive in a thermoplastic moulding composition comprising polyethylene terephthalate for reducing the acetaldehyde content of a moulded article formed from the composition.

It is also postulated that hindered amine light stabilisers may be capable of acting synergistically with acetaldehyde scavenges to reduce acetaldehyde content. Accordingly, the invention further provides the use of a hindered amine light stabiliser as an additive in a thermoplastic moulding composition comprising polyethylene terephthalate and an acetaldehyde scavenger for, synergistically with the acetaldehyde scavenger, reducing the acetaldehyde content of a moulded article formed from the composition

The thermoplastic polymer additive of the invention may be provided in a form suitable for direct addition to a thermoplastic melt or pre-melt granular composition. For example, the thermoplastic polymer additive may be uniformly dispersed in an inert liquid carrier therefor.

The thermoplastic moulding composition is preferably one that tolerates or requires high temperature processing conditions, for example use of an injection moulding temperature of at least about 200°C. Suitable materials include polyethylene terephthalate.

In order to mould articles from a thermoplastic moulding composition it is necessary to heat the composition to a temperature above its softening point. However, it is normally preferred to perform moulding at a temperature below the melting point of the thermoplastic polymer material present in the thermoplastic moulding composition. In the practice of the present invention, it will often be preferred to utilise thermoplastic polymer materials in the moulding composition which can tolerate, or which require the use of, high processing temperatures, for example temperatures of at least about 200°C. Some moulding processes may require the use of more severe processing conditions than others. For example, in the formation of a blow moulded polyethylene terephthalate bottle, injection temperatures in the range of from about 260°C to about 285 C or more, e.g. up to about 310°C, can be used in the course of forming a bottle preform whereas a lower temperature of, for example, from about 100°C up to about 170°C is typically used, in

combination with a suitable high air pressure of, for example, about 40 bar, in order to blow a bottle of the desired shape from the bottle preform.

Mechanical recycling procedures may involve the following steps:

1. Collection (e.g. of bottles). This is usually organised through bottle collection points and some times by street collection.

2. Colour sorting. This is often done manually although more in-line automated systems are becoming available. The commercial value of polyethylene terephthalate coloured bottles is: clear > blue > green> amber/other transparent and translucent colours > opaque. Clear, blue and green can be blended to give an acceptable final resin colour. Other colours find use either in strapping and staple fibre. There are also some applications in crates and pallets. The recycling of colourless or substantially colourless bottles to produce recycled colourless or substantially colourless bottles has been difficult because of the tendency of the recycled materials to yellow and/or become hazy.

3. Grinding. Typically the bottles are ground into fragments of typical thickness 0.15 to 0.4 mm in size of approximately 1 to 2 cm.

4. Separation of polyethylene terephthalate from contaminants. This is usually done by flotation or other means such as air separation. This removes closures, labels, internal barrier layers, soil etc.

5. Washing. Typical composition of a wash is 1.8% sodium hydroxide. Bottles are typically washed at 80°to 85°C. This removes external barrier layers, plus more importantly, microbiological material and potentially toxic compounds.

6. Drying. Usually by hot air.

7. Extrusion and pelletizing. A vacuum pump is employed to remove volatiles.

8. Solid stating. This is usually conducted by convected heating and 200°C for 8 to 12 hours, or longer – for example up to about 16 hours or even more. This increases the IV to the required level. For bottle blowing this is typically 0.72 - 0.84 dL/g.

The solid stating procedure in recycling has tended to cause a yellowing in polyethylene terephthalate materials, particularly in such materials that contain an acetaldehyde scavenger. It has now been discovered that in the recycling of a polyethylene terephthalate material that comprises an acetaldehyde scavenger, the addition to the recyclates of a hindered amine light stabiliser before the solid stating step can reduce this problem.

Hindered amine light stabilisers suitable for use in the present invention include: Chimassorb™ 944 (CAS No. 71878-19-8), also known as poly[6-[(1,1,3,3-tetramethylbutyl)amino]1,3,5-triazine-2,4-diyl]-[(2,2,6,6-tetramethyl-4-piperidyl)-imino]hexamethylene[(2,2,6,6-tetramethyl-4-piperidyl)imino], Chimassorb™ 2020 (CAS No.192268-64-7), also known as poly-[[6-[N-(2,2,6,6-tetramethyl-4-piperidinyl)-n-butylamino]-1,3,5-triazine-2,4-diyl][(2,2,6,6-tetramethyl-4-piperidinyl)imino]-1,6-hexanediyl[2,2,6,6-tetramethyl-4piperidinyl)imino]]-alpha-[N,N,N',N'-tetrabutyl-N''-(2,2,6,6-tetramethyl-4-piperidinyl)-N''-[2,2,6,6-tetramethyl-4-piperidinylamino)-hexyl]-[1,3,5 triazine-2,4,6-triamine]omega-N,N,N',N'-tetrabutyl-1,3,5-triazine-2,4-

diamine, Tinuvin™ 622 (CAS No.65447-77-0), Tinuvin™ 770 (Cas No. 52829-07-9), also known as sebacic acid, bis(2,2,6,6-tetramethyl-4-piperidyl)ester, and Cyasorb™ UV3346 (CAS No.082451-48-7), also known as poly(6-morpholino-1,3,5,-triazine-2,4,-diyl)[(2,2,6,6-tetramethyl-4-piperidyl)imino]-hexamethylene-[(2,2,6,6-tetramethyl-4-piperidyl)-imino]. Other suitable HALS will be apparent to those skilled in the art.

Acetaldehyde scavengers suitable for use in the present invention include Anthranilamide (1,8-diaminonaphalene), Allantoin (3,4-diaminobenzoic acid), Malonamide, Salicylanilide, 6-amino-1,3-dimethyluracil (DMU), 6-Aminoisocytosine, 6-Aminouracil, 6-Amino-1-methyluracil, α-tocopherol, triglycerin, trimethylolpropane, dipentaerythritol,tripentaerythritol,D-mannitol, D-sorbitol, and xylitol. Other acetaldehyde scavengers will be apparent to those skilled in the art.

Polyethylene terephthalate used for injection moulding purposes is typically post-condensed and has a molecular weight in the region of about 25,000 to 30,000. However, it has also been proposed to use a fibre grade polyethylene terephthalate that is cheaper but is non-post-condensed, with a lower molecular weight in the region of about 20,000. It has further been suggested to use co-polyethylene terephthalates of polyethylene terephthalate which contain repeat units from at least 85 mole % terephthalic acid and at least 85 mole % of ethylene glycol. Dicarboxylic acids which can be included, along with terephthalic acid, are exemplified by phthalic acid, isophthalic acid, naphthalene-2,6-dicarboxylic acid, cyclohexanedicarboxylic

acid, cyclohexanediacetic acid, diphenyl-4,4'-dicarboxylic acid, succinic acid, glutaric acid, adipic acid, azelaic acid and sebacic acid. Other diols which may be incorporated in the co-polyethylene terephthalates, in addition to ethylene glycol, include diethylene glycol, triethylene glycol, 1,4-cyclohexanedimethanol, propane-1,3-diol, butane-1,4-diol, pentane-1,5-diol, hexane-1,6-diol, 3-methylpentane-2,4-diol, 2-methyl pentane-1,4-diol, 2,2,4-trimethylpentane-1,3-diol, 2-ethylhexane-1,3-diol, 2,2-diethylpropane-1,3-diol, hexane-1,3-diol, 1,4-di(hydroxyethoxy)-benzene, 2,2-bis-(4-hydroxycyclohexyl)-propane, 2,4-dihydroxy-1,1,3,3-tetramethyl-cyclobutane, 2,2-bis-(3-hydroxyethoxyphenyl)-propane, and 2,2-bis-(4-hydroxypropoxyphenyl)-propane. In this specification the term "polyethylene terephthalate" includes not only polyethylene terephthalate but also such co-polyethylene terephthalates.

Injection moulding of polyethylene terephthalate and other polyethylene terephthalate moulding compositions is typically carried out using an injection moulding machine and a maximum barrel temperature in the range of from about 260°C to about 285 C or more, for example, up to about 310°C. The dwell time at this maximum temperature is typically in the range of from about 15 seconds to about 5 minutes or more, preferably from about 30 seconds to about 2 minutes.

It is well known within the industry that polyethylene terephthalate does not exhibit good gas barrier properties. When producing bottles that will be used to package carbonated drinks or alcoholic beverages it is desirable to prevent

carbon dioxide from escaping and being replaced by oxygen. It has accordingly been proposed to add a polyamide to the thermoplastic polyethylene terephthalate moulding composition in order to confer improved gas barrier properties on it. Alternatively a sandwich construction may be used in which nylon or an ethylene/vinyl alcohol resin is incorporated in a multi-layer preform which is then blow moulded to form a bottle having improved gas barrier properties.

The thermoplastic polymer additive of the invention may be added as a solid master batch in the form of granules or powder. Alternatively, the additive may be suspended or dissolved in a liquid carrier in order to ensure a uniform dispersion of the additive throughout the polyethylene terephthalate. The liquid carrier is generally an inert material, such as a hydrocarbon oil, an ester, an alcohol, or a mixture of two or more thereof. The liquid carrier is selected to be non-toxic, to have good compatibility with polyethylene terephthalate and to possess good solvent properties (if the additive is to be dissolved in the liquid carrier). Ideally, the quantity of carrier included in the composition is kept to a minimum in order that the properties of the polyethylene terephthalate are not adversely affected. The thermoplastic polymer additive composition of the present invention includes a thermoplastic polymer-compatible organic liquid carrier. Such a carrier must be compatible with the thermoplastic polymer material of the thermoplastic moulding composition and is preferably also compatible with the other components to be included in the thermoplastic moulding composition of the invention. Typical carriers include hydrocarbons, hydrocarbon mixtures, alcohols, esters and mixtures of two or

more thereof. Preferably the thermoplastic polymer-compatible organic liquid carrier is an oil based vehicle. Examples of such vehicles of the materials available as Clearslip™ 2 and Clearslip™ 3 from ColorMatrix Europe Ltd., of Unit 9-11, Unity Grove, Knowsley Business Park, Knowsley, Merseyside, L34 9GT.

The thermoplastic polymer additive composition may also include one or more further functional additives.

The amount of hindered amine light stabiliser used in the thermoplastic moulding composition of the invention is preferably less than 1000ppm, more preferably less than 500ppm, even more preferably less than about 250ppm, most preferably from about 10 to about 150ppm. For example, the hindered amine light stabiliser may be added in an amount of from 10 to 100ppm of the thermoplastic moulding composition.

The additive composition is made by mixing the dry additive or additives in the form of a powder with a liquid organic carrier, typically in a range of from about 1 to about 85 wt %, more usually in the range of from about 30 to about 50 wt %. The resulting additive composition comprising the hindered amine stabiliser and the acetaldehyde scavenger uniformly dissolved or dispersed in the liquid carrier can then be added to the thermoplastic polymer in ranges from about 0.0001% by weight to about 7% by weight, for example, from 0.01% by weight up to about 5% by weight, based upon the weight of thermoplastic polymer component used.

It is not desirable to use higher concentrations of the additive as this may interfere with the properties of the thermoplastic polymer material.

In another aspect of the present invention there is provided a method of making a moulded article from a colourless or substantially colourless thermoplastic moulding composition which comprises:

(a) providing a colourless or substantially colourless thermoplastic moulding composition comprising polyethylene terephthalate;

(b) admixing with the thermoplastic moulding composition at least one hindered amine light stabiliser and at least one acetaldehyde scavenger;

(c) heating the colourless or substantially colourless thermoplastic moulding composition; and

(d) moulding the hot colourless or substantially colourless thermoplastic moulding composition so as to form a moulded article.

Typically the colourless or substantially colourless thermoplastic moulding composition is injection moulded to form a bottle preform and the resulting bottle preform is then blow moulded to form a bottle.

The invention further provides a method of a making a blow moulded bottle from a polyethylene terephthalate moulding composition which comprises:

(i) providing a colourless or substantially colourless polyethylene terephthalate moulding composition;

(ii) admixing with the polyethylene terephthalate moulding composition at least one hindered amine light stabiliser and at least one acetaldehyde scavenger;

(iii) heating the colourless or substantially colourless polyethylene terephthalate moulding composition;

(iv) extruding the hot colourless or substantially colourless polyethylene terephthalate moulding composition so as to form a bottle preform; and

(v) blow moulding the bottle preform at a blow moulding temperature so as to form a colourless or substantially colourless bottle;

Also provided in accordance with another aspect of the present invention is a method of making a useful article which comprises:

(A) providing a colourless or substantially colourless thermoplastic moulding composition comprising polyethylene terephthalate;

(B) admixing with the thermoplastic moulding composition at least one hindered amine light stabiliser and at least one acetaldehyde scavenger;

(C) forming a colourless or substantially colourless moulded article by a procedure including heating the colourless or substantially colourless thermoplastic moulding composition;

(D) after use of the moulded article, subjecting the material of the moulded article to recycling steps which include subjecting the material of the moulded article to elevated temperature conditions for a prolonged period of time; and

(E) re-forming the thus treated material into a useful article.

Also provided in accordance with another aspect of the present invention is a method of making a useful article which comprises:

(A) providing a colourless or substantially colourless thermoplastic moulding composition comprising polyethylene terephthalate and an acetaldehyde scavenger as an additive;

(B) forming a colourless or substantially colourless moulded article by a procedure including heating the colourless or substantially colourless thermoplastic moulding composition;

(C) after use of the moulded article, admixing with the material of the moulded article at least one hindered amine light stabiliser;

(D) subjecting the resulting material of the moulded article to recycling steps which include subjecting the material of the moulded article to elevated temperature conditions for a prolonged period of time; and

(E) re-forming the thus treated material into a useful article.

In the re-forming step (E) typically techniques that can be used include moulding, extrusion, and other conventional processes for making articles of plastics materials, including bottles and fibres.

In such a method the colourless or substantially colourless thermoplastic (i.e. polyethylene terephthalate) moulding composition in step (B) can be injection moulded to form a bottle preform and then the resulting bottle preform can be blow moulded to form a bottle.

The invention further provides a method of making an article from a colourless or substantially colourless thermoplastic moulding composition that comprises:

(I) providing a colourless or substantially colourless thermoplastic moulding composition comprising recycled colourless or substantially colourless thermoplastic material, said recycled colourless or substantially colourless thermoplastic material containing at least one acetaldehyde scavenger;

(II) admixing with the thermoplastic moulding composition an additive comprising a hindered amine light stabiliser; and

(III) extruding the resultant composition to form said article.

The article of step (III) may be a moulded article, such as a bottle preform, or a fibre or any other useful article, such as a tube, a crate, or the like.

Whilst a number of the aspects of the present invention utilise a moulding composition/polyethylene terephthalate which is colourless or substantially colourless, a coloured moulding composition may also be used. Preferably, should a coloured moulding composition be used, it will be of a blue colour.

Polyethylene terephthalate is hygroscopic and after a period of approximately one year it is noticeable that preforms made of polyethylene terephthalate have taken up moisture from the air. Therefore, prior to the injection moulding process, polyethylene terephthalate granules for use in the invention are preferably dried for at least about 6 hours at from about 160°C to about

190°C, in a procedure that gives a slightly tactile product. The polyethylene terephthalate granules are transferred directly from the drier to the hopper of the injection-moulding machine. The hindered amine light stabiliser can then be added to and mixed with the thermoplastic polymer granules upon charging to the hopper. The injection moulding process typically occurs at between about 260°C and about 285°C, more preferably at about 270°C, and the thermoplastic polymer material has a dwell time within the machine of less than 1 minute. Once the preform has been blow moulded into an appropriate article, said article may be recycled by a suitable procedure which includes use of temperatures of up to about 300°C or greater and dwell times up to or in excess of 5 minutes, and sometimes for many hours.

The invention is further illustrated in the following examples.

Example 1

Acetaldehyde scavenging agent and experimental anti-yellowing agent were incorporated at appropriate levels into VORIDIAN 9921w polyethylene terephthalate (PET) resin which was moulded into a 35g weight bottle blowing preform using a HUSKY injecting moulding machine. The preform was then transferred to a bottle-blowing machine, reheated by an infrared lamp and stretch blown into a 1litre bottle.

The blown bottle was then ground to fragments and washed with hot water, to simulate the recycle process. After washing the fragments of simulated

recycled PET were dried by heating them at approximately 160°C for five (5) hours and were then extruded at 270°C using a laboratory extrusion rig and cut into granules.

The experimental recycled PET granules were then crystallised by holding at 180°C for six (6) hours and then transferred to a batchwise rotation vacuum solid state polymerisation machine. During the Solid State Polymerisation (SSP) process the recycled PET granulate was first subjected to a temperature of 220°C for sixteen (16) hours and then allowed to cool to below a temperature of 170°C.

The simulated recycled PET granulate was then injection moulded into 2.5mm thick plaque using a BOY 22M injecting moulding machine in order to prepare samples for optical analysis.

The % light transmission over the wavelength range 400 nm to 700 nm and the colour spectrum data, CIE lab b*, which indicates the yellowness of the experimental plaque was determined using a MINOLTA Spectrophotometer CM-3700d.

The results are tabulated below:

COMPOSITION EXAMINED	% TRANSMISSION	
	@ 450 nm	@ 550 nm
Anthranilamide plaque before recycle	79	84

Anthranilamide plaque after recycle	71	79
Anthranilamide+Chimasorb plaque after recycle	74	81

A second HALS (Cyasorb UV-3346) was tested and found to have a similar but lesser effect

The increased use of the acetaldehyde reducing agent Anthranilamide in PET used to blow bottles has been found to cause a reduction in the light transmission and an increase in the yellow tint of PET when the bottles are recycled. The addition of Chimassorb 944 (Hindered Amine Light Stabiliser) in addition to the anthranilamide reduced the loss of transparency (6% increase in transmission at a wavelength of 450 nm).

Example 2

In this example the acetaldehyde reducing properties of HALS in conjunction with conventional acetaldehyde reducers/scavengers are demonstrated.

Preparation of Experimental Samples

Three parallel experiments were carried out. The experimental procedure varied only in the number and level of acetaldehyde reducer/scavenger and HALS agents added to the commercial PET.

Cleartuf P82 polyethylene terephthalate was loaded into a commercial injection-moulding machine (Netstal HP3500). Depending on the experiment the following additions were made

EXPERIMENT 1 No Additive

EXPERIMENT 2 0.033% (on weight of PET) Anthranilamide acetaldehyde scavenging agent

EXPERIMENT 3 0.033% (on weight of PET) Anthranilamide acetaldehyde scavenging agent and 0.006% Chimassorb 944

Each mixer charge was injection moulded into a 47g weight bottle blowing preforms.

Samples were taken from each of the experimental preforms and set aside for individual examination for acetaldehyde content.

Acetaldehyde Analysis

Each sample was immersed in liquid nitrogen and subsequently ground down by Retsch grinder to a particle size less than 1mm and subjected to chromatographic analysis for free acetaldehyde concentration using a Perkin Elmer XL gas chromatograph with FID detector. Pure acetaldehyde (99.5%) was obtained from Sigma Aldrich for calibration purposes.

EXPERIMENTAL OBSERVATION

With reference to the table of results below, the addition of Chimasorb 944 (Hindered Amine Light Stabiliser) in addition to anthranilamide (acetaldehyde reducing agent) to PET prior to injection moulding the PET causes an unexpected further lowering of acetaldehyde level in the injection moulded article (bottle pre-form) relative to the anthranilamide alone (28% reduction).

COMPOSITION EXAMINED	ACETALDEHYDE LEVEL (ppm)	% REDUCTION
PET (Cleartuf P82) with no additives	6.9	
PET (Cleartuf P82) with 0.033% active Anthranilamide	3.9	43
PET with 0.033% active Anthranilamide+0.0060% Chimassorb 944	2.8	59.1

CLAIMS

1. Use of a hindered amine light stabiliser as an additive in a thermoplastic moulding composition comprising polyethylene terephthalate and an acetaldehyde scavenger for reducing the degree of discolouration and/or increasing the degree of light transmission of a moulded article formed from the composition.

2. Use according to claim 1 wherein the moulding composition is subjected to a solid stating procedure after addition of the hindered amine light stabiliser and before formation of the moulded article.

3. Use according to claim 2 wherein the moulding composition is a recyclate.

4. Use of a hindered amine light stabiliser as an additive in a thermoplastic moulding composition comprising polyethylene terephthalate and an acetaldehyde scavenger for, synergistically with the acetaldehyde scavenger, reducing the acetaldehyde content of a moulded article formed from the composition.

5. Use of a hindered amine light stabiliser as an additive in a thermoplastic moulding composition comprising polyethylene terephthalate for reducing the acetaldehyde content of a moulded article formed from the composition.

6. Use according to any preceding claim, wherein the polyethylene terephthalate is coloured.

7. Use according to any preceding claim, wherein the polyethylene terephthalate is a blue colour.

8. A thermoplastic polymer additive composition for addition to a thermoplastic moulding composition comprising polyethylene terephthalate, said additive composition comprising at least one hindered amine light stabiliser and at least one acetaldehyde scavenger.

9. An additive composition according to claim 8, wherein the polyethylene terephthalate is coloured.

10. An additive composition according to either claim 8 or 9, wherein the polyethylene terephthalate is a blue colour.

11. A method of making a moulded article from a colourless or substantially colourless thermoplastic moulding composition which comprises:

(a) providing a colourless or substantially colourless thermoplastic moulding composition comprising polyethylene terephthalate;

(b) admixing with the thermoplastic moulding composition at least one hindered amine light stabiliser and at least one acetaldehyde scavenger;

(c) heating the colourless or substantially colourless thermoplastic moulding composition; and

(d) moulding the hot colourless or substantially colourless thermoplastic moulding composition so as to form a moulded article.

12. A method according to claim 5 of a making a blow moulded bottle from a polyethylene terephthalate moulding composition which comprises:

(i) providing a colourless or substantially colourless polyethylene terephthalate moulding composition;

(ii) admixing with the polyethylene terephthalate moulding composition at least one hindered amine light stabiliser and at least one acetaldehyde scavenger;

(iii) heating the colourless or substantially colourless polyethylene terephthalate moulding composition;

(iv) extruding the hot colourless or substantially colourless polyethylene terephthalate moulding composition so as to form a bottle preform; and

(v) blow moulding the bottle preform at a blow moulding temperature so as to form a colourless or substantially colourless bottle;

13. A method of making a useful article which comprises:

(A) providing a colourless or substantially colourless thermoplastic moulding composition comprising polyethylene terephthalate;

(B) admixing with the thermoplastic moulding composition at least one hindered amine light stabiliser and at least one acetaldehyde scavenger;

(C) forming a colourless or substantially colourless moulded article by a procedure including heating the colourless or substantially colourless thermoplastic moulding composition;

(D) after use of the moulded article, subjecting the material of the moulded article to recycling steps which include subjecting the material of the moulded article to elevated temperature conditions for a prolonged period of time; and

(E) re-forming the thus treated material into a useful article.

14. A method of making a useful article which comprises:

i. providing a colourless or substantially colourless thermoplastic moulding composition comprising polyethylene terephthalate and an acetaldehyde scavenger as an additive;

ii. forming a colourless or substantially colourless moulded article by a procedure including heating the colourless or substantially colourless thermoplastic moulding composition;

iii. after use of the moulded article, admixing with the material of the moulded article at least one hindered amine light stabiliser;

iv. subjecting the resulting material of the moulded article to recycling steps which include subjecting the material of the moulded article to elevated temperature conditions for a prolonged period of time; and

v. re-forming the thus treated material into a useful article.

15. A method of making an article from a colourless or substantially colourless thermoplastic moulding composition that comprises:

a) providing a colourless or substantially colourless thermoplastic moulding composition comprising recycled colourless or substantially colourless thermoplastic material, said recycled colourless or substantially colourless thermoplastic material containing at least one acetaldehyde scavenger;

b) admixing with the thermoplastic moulding composition an additive comprising a hindered amine light stabiliser; and

c) extruding the resultant composition to form said article.

16. A method according to any of claims 11 to 15, wherein the colourless or substantially colourless moulding composition is replaced with a coloured moulding composition.

17. A method according to claim 16, wherein the coloured moulding composition is blue.

ABSTRACT

Use of a hindered amine light stabiliser as an additive in a thermoplastic moulding composition comprising polyethylene terephthalate and an acetaldehyde scavenger for reducing the degree of discolouration and/or degree of light transmision of a moulded article formed from the composition